3.4 QUALITY CONTROL FOR EQUIPMENT-CLEANING PROCEDURES

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Quality-control samples are required for any sampling and analysis program. Without quality-control information, the quality of the environmental data collected can be neither evaluated nor qualified. If the user has no means of knowing the associated errors, the data cannot be interpreted properly.

The purpose for obtaining quality-control (QC) samples following equipment cleaning is to ensure that the equipment and the procedures used for cleaning the equipment do not contaminate or otherwise affect the environmental samples that were or will be collected. The QC sample used to assess the adequacy of cleaning procedures before field work commences is called the equipment blank.

- Blank water. Blank water is used to develop specific types of QC samples (National Water Quality Laboratory Memorandum 92.01). The water is a solution that is free of analyte(s) of interest at a specified detection level. USGS personnel are required to use blank water that has been analyzed and certified to be of a specific grade and composition.
  - Use IBW to collect blank samples for analysis of inorganic constituents.
  - Use PBW to collect blank samples for analysis of pesticides. (Do not use PBW when collecting samples for VOC analysis.)
  - Use VBW to process blank samples for analysis of VOCs. VBW is also suitable as a blank sample for pesticide analysis.
  - Use PBW or VBW as the quality-control sample for total and dissolved organic-carbon analysis (TOC and DOC). This cannot be documented as a blank sample because neither PBW nor VBW is certified to be free of organic carbon.

- Equipment blank. An equipment blank is blank water that is processed under controlled conditions in the office laboratory by being passed sequentially through each component of the sample processing and collection equipment. An equipment blank represents an entire sampling system (fig.3-7) and is required:
  - Annually.
  - When a cleaning procedure is followed for the first time.
  - When new equipment will be used for the first time.

To fulfill equipment-blank requirements:

1. Allow enough time in the study workplan to collect the annual equipment blank, complete laboratory analyses, and review analytical results before field work for the study commences.
2. Process the annual equipment blank in a clean, controlled environment in the office laboratory, after the equipment has been cleaned using office-laboratory procedures.
3. Analyze the annual equipment-blank data before collecting and processing the first water-quality sample of either the fiscal year or the study.
   - If the equipment-blank data indicate that the equipment does not introduce contaminants that will bias study results, sampling can proceed.
   - If the equipment-blank data indicate unacceptable concentrations of analytes of interest, the cause must be identified and the equipment or cleaning procedures must be changed or modified before sampling can proceed.

Plan ahead: Assess equipment-blank data before environmental samples are collected.

- Field blank. The field blank is blank water that is processed at the field site by being passed sequentially through each component of the equipment being used to collect environmental samples. The procedure for processing the field blank, like the equipment blank, can also result in a set of sequentially collected blank samples (fig. 3-7) (Horowitz and others, 1994). Other types of blank samples also are collected at the field site (NFM 4). At least one field blank per sampling run is recommended; the numbers and distribution of QC samples depend on study objectives, the target analytes, and site conditions.

  - Process field blanks through clean equipment.

  - If equipment is used at several sites during a field trip, process a field-equipment blank after the last sample has been collected and again after the equipment has undergone the prescribed field-cleaning procedures.

  - If multiple sets of office-cleaned equipment are used during a field trip, process a field blank at any site during the course of the trip. In this case, the blank must be processed before sampling to avoid contaminating the blank with residues from an environmental sample.

  - Process field blanks onsite and under the same conditions as the environmental sample.

Before filling the QC sample bottle with the appropriate blank water:

1. Check that sample bottles are clean, are the correct type, and are labeled correctly.

2. Check the certificate of analysis for the lot of blank water to be sure that it is appropriate for quality control of target analytes.

3. Record the date and lot number of the IBW, PBW, and (or) VBW used and of the preservative used. To the extent possible, use preservative from the same lot number for an entire sampling trip for both the environmental and quality-control samples.

4. Rinse sample bottles for inorganic constituents three times with a small quantity of the blank water.

Use the following strategy for QC data collection and analysis:

1. For inorganic-constituent samples, initially send only the final equipment-blank sample for the routine inorganic blank-sample analysis or for inorganic analytes targeted by the study.

   - Archive the remaining sequentially processed blank samples (fig.3-7) until the inorganic-constituent analysis of the equipment-blank sample has been received.

   - Do not archive blank samples for organic-compound analysis.

2. Check the analytical results for the equipment blank and field blanks as soon as possible and before the next field trip.

   - If analytical results indicate that the equipment is clean within acceptable limits, the equipment may be used for field work without additional testing or analysis.

   - Use of equipment is not recommended if analysis of the equipment blank sample indicates greater than acceptable analyte concentrations.

3. Additional QC data collection and (or) analysis is required if the equipment blank has greater than acceptable analyte concentrations.

   - For inorganic-sample analysis. Submit the rest of the sequential blank samples for laboratory analysis and use the analytical results from the sequential blank samples to identify potential source(s) of contamination. Modify equipment-cleaning procedures if contamination can be remedied by a change in cleaning procedure. Repeat collection of equipment blanks until the blank data verify that the equipment is suitable for use.

   - For organic-sample analysis. Modify the equipment cleaning procedure if the source of contamination is known or suspected and contamination can be remedied by a change in cleaning procedure. If the source of contamination is not known, reclean equipment using office-laboratory procedures and collect and analyze blanks for each part of the sampling system that could be a source of contamination. Repeat collection of equipment blanks until the blank data verify that the equipment is suitable for use.

The equipment blank is the last sample of a set of sequentially processed blanks collected in the office laboratory and documents the suitability of the equipment for the samples that are to be collected and analyzed. Field blanks are collected in the field in the same manner as the equipment blank but document the effectiveness of the field-cleaning procedures plus any ambient contamination.

- Surface water: collect the series of five sequential blank samples listed below for routine surface-water sampling.
- Ground water: collect the source-solution blank (Sample 1) and either a sampler blank (Sample 2) or pump blank (Sample 4) (depending on the type of sampling device being used) along with the filter blank (Sample 5) .

Sample 1. SS blank	Source solution (SS) Put on disposable gloves. Pour the IBW, PBW, or VBW directly into appropriate SS blank-sample bottle.[1] Add chemical treatment and (or) chill, as required for the analytes of interest.
Sample 2. Sampler blank	SS + Sampler Bottle or bag sampler: Fill sampler container with SS; attach sampler cap and nozzle; decant sample into blank-sample bottle through the nozzle. Preserve sample (add chemical treatment and (or) chill) as required (NFM 5). Bailer or thief sampler: Fill sampler with SS; install bottom-emptying device; empty sample into blank-sample bottle through the bottom-emptying device. Preserve sample, as required. Submersible or nonsubmersible pumps: Go to Sample 4 (Pump blank).
Sample 3. Splitter blank	SS + Sampler + Splitter[2] If a cone or churn splitter is used, decant remainder of the SS into sampler container, and then through splitter (through nozzle or bottom-emptying device). Refill sampler container with SS to fill churn with 3 to 5 liters of water. Alternatively, pour enough SS from samplers through cone splitter to fill splitter-blank bottle. Collect SS into blank-sample bottle through churn spigot or cone-splitter exit port(s). Preserve sample, as required.
Sample 4. Pump blank	SS + Sampler + Splitter + Pump Nonsubmersible pump (peristaltic, vacuum, or valveless metering pump): Secure intake end of clean pump tubing into churn splitter or into a subsample split with the cone splitter. Pump some sample to waste to rinse tubing, and fill pump-blank bottle directly from the discharge end. Preserve sample, as required. Submersible pump: Place pump in blank-water standpipe and fill standpipe with enough SS to cover pump intake and allow for drawdown. Start pump at low pumping rate, discharge 0.5 liter of SS to waste, then fill blank-sample bottle with SS. Preserve sample, as required.
Sample 5. Filter or equipment blank	SS + Sampler + Splitter + Pump + Filter Pump SS through a prerinsed filtration assembly (plate filter or capsule filter); pump the first aliquot to waste and then pump SS directly into the blank-sample bottle. Preserve sample, as required.

[1]Process the source-solution blank in the protected environment of the office laboratory only, not in the field (NFM 4).

[2]For ground-water quality control: A splitter blank is included if a cone splitter is used; a standpipe blank often is collected if a submersible pump is used.

Figure 3-7. Sequence of sample collection to obtain the equipment blank